

## The Genus *Braunia* (Bryopsida, Hedwigiaceae) in China

SI HE

Missouri Botanical Garden, P.O. Box 299, St. Louis, MO 63166-0299, U.S.A. e-mail: si.he@mobot.org

EFRAÍN DE LUNA

Departamento de Sistemática Vegetal, Instituto de Ecología, AC, Xalapa, Veracruz 91000, México; e-mail: deluna@ecologia.edu.mx

**Abstract.** Diagnoses are given for *Braunia alopecura* (Brid.) Limpr. and *B. delavayi* Besch. A key to two species of *Braunia* in China is provided. *Braunia obtusiscuspis* Broth. is synonymized with *Hedwigidium integrifolium* (P. Beauv.) Dix.

**Keywords.** *Braunia*, bryophytes, China, flora, Hedwigiaceae, *Hedwigidium*, moss.

In connection with the Moss Flora of China project, our attention was brought to the taxonomic treatments of *Braunia* for the country. The species concept surrounding *Braunia delavayi* Besch. as interpreted by Chinese authors has been revised by De Luna (1992). This species has been misunderstood in China by nearly all of the recent treatments (Redfearn et al. 1996), thus its delimitation needs to be reviewed. Numerous Chinese specimens of *Braunia*, deposited at DUKE, MO, and NY, are not *B. delavayi*, and these specimens represent *B. alopecura* (Brid.) Limpr., a new record for China. Misunderstanding of *Braunia delavayi* probably began with the treatment of *Genera Muscorum Sinicorum* presented and illustrated by P.-C. Chen et al. (1978). Since then, all Chinese authors treated *B. alopecura* as *B. delavayi* (Z.-L. Liu & C.-H. Gao 1989; Z.-L. Liu et al. 1993; J.-X. Luo 1985, 2000; P.-C. Wu et al. 1981). The purposes of this paper are to provide a modern concept of *Braunia delavayi* and to report *B. alopecura* new to China. The present study of the genus *Braunia* in China also shows that *Braunia obtusiscuspis* Broth. is a synonym of *Hedwigidium integrifolium* (P. Beauv.) Dix. The publication of this treatment is important for the upcoming treatment of the Hedwigiaceae in the Moss Flora of China, English Version.

The genus *Braunia* is characterized by the ecostate leaves; thick-walled, sinuous leaf cells with pleuripapillose longitudinal walls; long setae; gymnostomous (eperistomate) and usually cylindrical capsules; cucullate calyptrae; and an exosporic globular protonema (De Luna 1992). Two species of *Braunia*, *B. delavayi* and *B. obtusiscuspis*, both endemic, were described from China (Bescherelle 1892; Brotherus 1923). The type of *Braunia obtusiscuspis* is identical to that of *Hedwigidium integrifolium*, thus is a synonym of the latter species.

*Hedwigidium integrifolium* has a small, strongly subtubulose calyptra; a short seta with an immersed capsule; and very broad perichaetial leaves with undulate margins.

*Braunia delavayi* is similar to *B. attenuata* (Mitt.) Jaeg., an Indian species, but differs in having a higher conic base of the operculum and the absence of multicellular spores (De Luna 1992). As *B. attenuata* is maybe found in China, it is included in the key. The two species are primarily different in their sporophytes and without seeing spores and opercula they are difficult to separate.

### KEY TO SPECIES

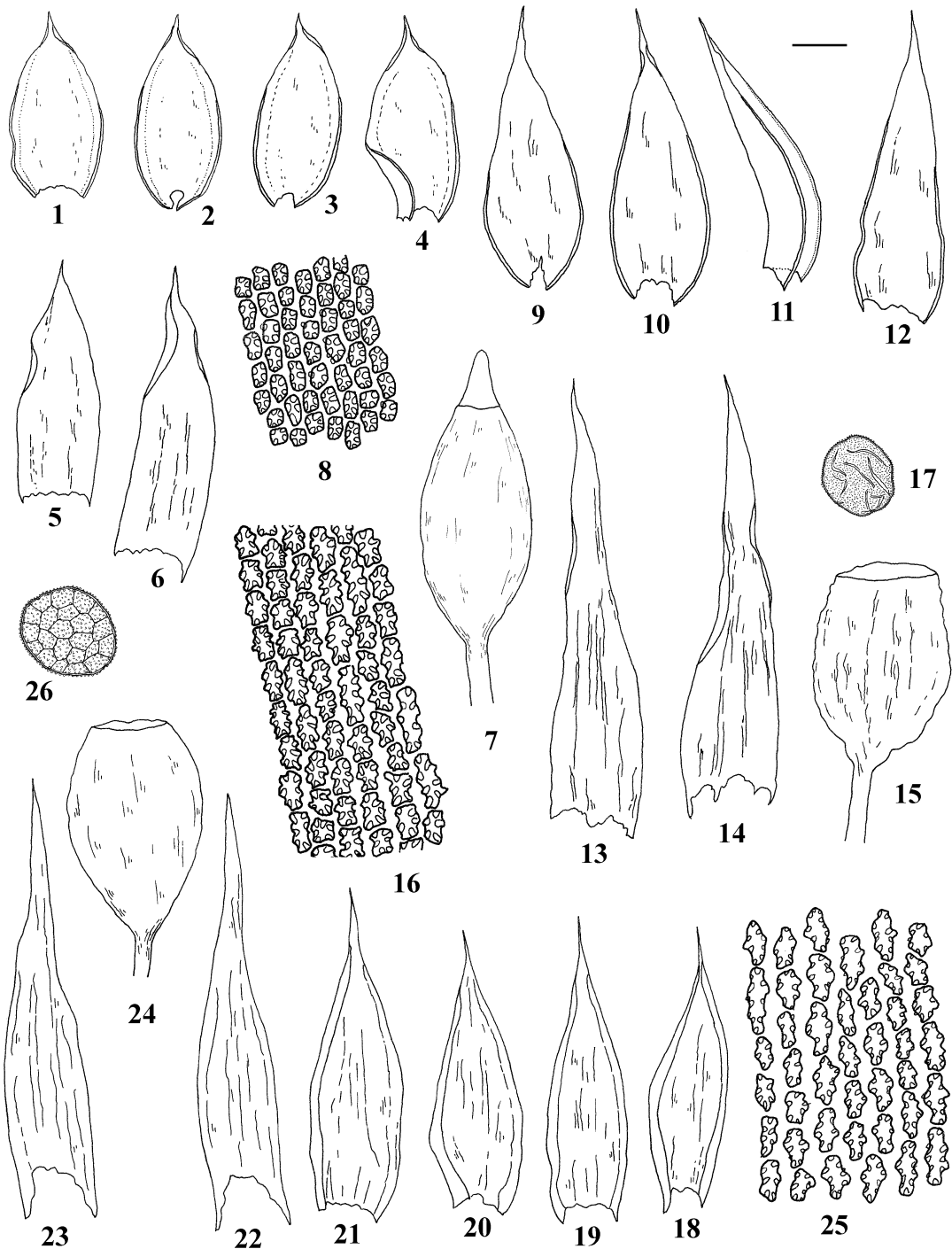
1. Upper leaf cells 10–12  $\mu\text{m}$  long, quadrate or shortly rectangular (1–2:1), slightly sinuous; leaf lamina concave, ovate or broadly ovate, imbricate; apex sharply differentiated, very short, mucronate, subtubulose; capsules cylindrical to oblong-ellipsoidal ..... 1. *B. alopecura*
1. Upper leaf cells 12–23  $\mu\text{m}$ , narrowly elongate (2–5:1), very sinuous; leaf lamina mostly flat, narrowly lanceolate, spreading; apex gradually differentiated, long acuminate to subulate, more than 1/3 leaf length; capsules urceolate ..... 2
2. Spores multicellular, 30–40  $\mu\text{m}$ ; operculum with a low conic base ..... 2. *B. attenuata* (India)
2. Spores unicellular, 22–30  $\mu\text{m}$ ; operculum with a high conic base ..... 3. *B. delavayi* (China)

### 1. BRAUNIA ALOPECURA (Brid.) Limpr., Laubm. Deutschl. 1: 824. 1889. FIGS 1–8

*Leucodon alopecurus* Brid., Muscol. Recent. Suppl. 4: 135. 1819[1818]. TYPE: SWITZERLAND. “in Helvetia locis accuratis non designatis”, *Schleicher s.n.* (JE!, holotype; BM!, isotype).

*Anoetangium sciurioides* Bals. & De Not., Mem. Reale Accad. Sci. Torino 40: 345. 1838. TYPE: ITALY. “in valle Levantina Helvetiae Ticinensis”. *Brambilla s.n.* (BM!, holotype).

*Hedwigia sciurioides* (Bals. & De Not.) Bals. & De Not., Syllab. Musc. 95. 1838.



FIGURES 1-26. *Braunia alopecura* 1-8 (Redfearn et al. 1371, MO); *Braunia delavayi* 9-17 (Redfearn et al. 718, MO); *Braunia attenuata* 18-26 (Strachey & Winterbottom s.n., NY). — 1-4, 9-12, 18-21. Stem leaves. — 5-6, 13-14, 22-23. Perichaetial leaves. — 7, 15, 24. Capsules. — 8, 16, 25. Median and upper leaf cells. — 17, 26. Spores. Scale bar = 0.5 mm for 1-7, 9-15, 18-24; bar = 20  $\mu$ m for 8, 16-17, 25-26.

- Braunia sciuroides* (Bals. & De Not.) Bruch & Schimp. in B.S.G., Bryol. Eur. 3: 161. 1846. (Fasc. 29–30. Monogr. 3).
- Harrisonia sciuroides* (Bals. & De Not.) Rabenh., Deutschl. Krypt.-Fl. 2(3): 153. 1848.
- Neckera alopecura* (Brid.) Müll. Hal., Syn. Musc. Frond. 2: 104. 1851.
- Hedwigia alopecura* (Brid.) Kindb., Canad. Rec. Sc. 6: 18. 1894.

Plants slender, yellowish brown, in lax mats; stems with sympodial branching; branches arcuate to erect; flagelliform branches differentiated; pseudoparaphyllia foliose, with papillose cells. Leaves ovate or oblong-ovate, 1.2–2.0 mm long, concave, imbricate, apex sharply differentiated, very short, mucronate, subtubulose; upper and median leaf cells 10–12  $\mu\text{m}$ , quadrate or shortly rectangular (1–2:1), with slightly sinuous longitudinal walls, luminal papillae small or absent, papillae on longitudinal walls; alar cells shortly rectangular or quadrate. Archegonia distal on vaginula; perichaetial leaves 1.8–2.2 mm, wide oblong, short acuminate; perichaetial paraphyses long. Setae elongate, 8–10 mm long; urns 2.0–2.3 mm long, cylindric to oblong-ellipsoidal, irregularly wrinkled, neck long, gradually attenuate, mouth narrower than widest part of capsule; stomata superficial; opercula conic at base, rostrate, long and slender. Calyptrae large, cucullate, covering most of capsule. Spores unicellular, 25–30  $\mu\text{m}$  in diameter.

*Braunia alopecura* is characterized by a subtubulose acumen in vegetative and perichaetial leaves; usually cylindric to oblong-ellipsoidal capsules; reflexed margins at the leaf bases; and oblong-ovate, weakly plicate leaves.

*Habitat*.—On granite boulders or stream banks; elevation 2,200–2,550 m.

*Distribution*.—China, Cape Verde Is (*Byström* 177, s), France, Germany (*Weber s.n.*, 1885, JE), India, Iran, Italy (*Artaria s.n.*, 1897, JE), Kuwait, and Switzerland (*Pasquale s.n.*, Sept 1995, BM).

*Specimens examined*.—CHINA. YUNNAN. Dali Co., 25°42' N, 100°07' E, *Redfearn, He & Su* 1371 (FH, HKAS, MO, PE), 25°28' N, 100°28' E, *Redfearn, He & Su* 1076, 1094 (both in FH, HKAS, MO, PE).

2. **BRAUNIA ATTENUATA** (Mitt.) Jaeg., Ber. Thatigk. St. Gallischen Naturwiss. Ges. 1869–70: 172. 1871. (Gen. Sp. Musc. 1: 88). FIGS 18–26

*Hedwigia attenuata* Mitt., J. Proc. Linn. Soc., Bot., Suppl. 1: 123. 1859. TYPE: INDIA. West Himalayas, Kumaon, alt. 10,500 ft., *Strachey & Winterbottom s.n.* (NY!, holotype; BM!, s!, isotypes).

Plants slender, mats lax; stems with sympodial branching; branches slender, pointed, attenuate; flagelliform branches present; pseudoparaphyllia foliose. Leaves spreading to erect squarrose, weakly

plicate, slightly flat to concave, margins recurved, up to acumen, leaf base high with widest point of leaf in lower half, narrowly lanceolate, 2.2–2.7  $\mu\text{m}$  long, acuminate, marginal cells entire to papillose crenulate at acumen, apex flat, concolorous; apical leaf cells elliptic, 25–35  $\mu\text{m}$  long, with few low papillae; upper and median cells 15–23  $\mu\text{m}$  long-elliptic, walls nodulose, papillae low, on side walls. Autoicous. Archegonia on medial portion of long vaginula; perichaetial leaves 3.0–3.5 mm long, narrowly lanceolate, long acuminate; perichaetial paraphyses longer than archegonia, immersed. Setae 7–15 mm long; capsule neck shortly attenuate to scarcely differentiated, urns 2.3–2.9 mm, broadly ellipsoidal, mouth broad, nearly as wide as capsules, capsule walls wrinkled, exothecial cells polygonal; opercula low conic, long rostrate. Calyptrae cucullate, large. Spores multicellular, 30–40  $\mu\text{m}$  in diameter.

*Habitat*.—On trees; elevation 2,400–2,500 m.

*Distribution*.—India.

*Specimen examined*.—INDIA. Nilgiri-Berge, am Dodabetta, Oberhalb, *M. Fleischer* B3088 [B, MO, as *Braunia secunda* (Hook.) Bruch & Schimp.].

3. **BRAUNIA DELAVAYI** Besch., Ann. Sci. Nat., Bot., ser. 7, 15: 71. 1892. TYPE: CHINA. Yunnan, sur le tronc des vieux arbres, bois de Koua-la-po (Hokin), à 3,000 mètres d'altitude, 4 août 1885, *Delavay n° 1645* (BM!, holotype; H!, NY!, P, S!, isotypes). FIGS 9–17

Plants yellowish brown, in lax mats; stems with sympodial branching; branches flexuose, slender, with pointed, attenuate tips; flagelliform branches present; pseudoparaphyllia foliose. Leaves narrowly lanceolate, 2.0–2.6 mm long, erect, patent, spreading squarrose, weakly plicate below, flat or only slightly concave at base; margins narrowly recurved to strongly revolute up to acumen, low base, widest point below middle of leaf, acumen long, acute to acuminate, flat, concolorous; margins entire, papillose crenulate at acumen; apical cells 22–31  $\mu\text{m}$  long, elliptic, narrow, with few low marginal papillae, overarching lumen, unbranched; upper and median cells 12–20  $\mu\text{m}$  long, elliptic, walls nodulose, papillae low, on side walls. Autoicous. Archegonia medial on long vaginula; perichaetial leaves narrowly lanceolate, 3.2–4.7 mm long, narrowly acuminate; perichaetial paraphyses longer than archegonia. Setae 7–15 mm long; capsule neck shortly attenuate, urns 1.5–2.0 mm long, broadly ellipsoidal when dry, subglobose when moist, turbinate, broad mouth nearly the same width as capsule, capsule walls wrinkled, exothecial cells polygonal; opercula long rostrate with a high conic

base. Calyptrae cucullate, large. Spores unicellular, 25–30  $\mu\text{m}$  in diameter.

*Habitat*.—On trees; elevation 2,600–3,200 m.

*Distribution*.—Endemic to China.

*Specimens examined*.—CHINA. YUNNAN. *Delavay 1641* (BM, H), *Delavay s.n.*, 1885 (BM), *Delavay s.n.*, 1888 (BM), *Delavay s.n.*, 9 April 1889 (NY); Yangbi Co., 25°50' N, 99°59' E, *Redfearn, He & Su 958, 967* (HKAS, MO, PE), 25°46' N, 100°01' E, *Redfearn, He & Su 718* (HKAS, MO, PE).

The plants of *B. delavayi* clearly have slenderly acuminate leaf apices. However, Brotherus (1925) defined *B. delavayi* in the group of species without hairy (slender) leaf tips similar to those of *B. alopecura*. That was probably the reason all Chinese authors followed the wrong treatment of this species. Another reason that *Braunia delavayi* and *B. alopecura* have been confused in China is because the latter species has not been known from China before now. The name widely used in the Chinese literature for *B. delavayi* has been *B. alopecura*. The interpretation of this species by Chinese authors (e.g., P.-C. Chen et al. 1978; J.-X. Luo 1985, 2000) is consistent with *B. alopecura*. On the other hand, *B. alopecura* may be confused with *Hedwigidium integrifolium* and some specimens of *B. alopecura*, especially those sterile ones, may be misidentified as *H. integrifolium*.

**HEDWIGIDIUM INTEGRIFOLIUM** (P. Beauv.) Dix. in C. Jens., Skand. Bladmossfl. 369. 1939.

*Hedwigia integrifolia* P. Beauv., Prodr. Aethogam. 60. 1805.

*Anoetangium integrifolium* (P. Beauv.) Schwaegr., Sp. Musc. Frond., Suppl. 1, 1: 38. 1811.

*Gymnostomum imberbe* Smith, Engl. Bot. 32: 2237. 1811.

*Hedwigidium imberbe* (Smith) Bruch & Schimp. in B.S.G., Bryol. Eur. 3: 157. 274. 1846. (Fasc. 29–30 Mon. 1, 1).

*Harrisonia rhabdocarpa* Hampe, Linnaea 32: 148. 1863.

*Braunia rhabdocarpa* (Hampe) Müll. Hal., Linnaea 42: 378. 1879.

*Hedwigia rhabdocarpa* (Hampe) Kindb., Enum. Bryin. Exot. 15. 1888.

*Braunia teres* Müll. Hal., Flora 71: 415. 1888.

*Braunia novae-seelandiae* Müll. Hal., Trans. & Proc. New Zealand Inst. 26: 275. f. 26. 1894.

*Hedwigidium teres* (Müll. Hal.) Par., Index Bryol. 555. 1896.

*Braunia erosa* Müll. Hal., Hedwigia 38: 124. 1899.

*Braunia macowaniana* Müll. Hal., Hedwigia 38: 123. 1899.

*Braunia maritima* Müll. Hal., Hedwigia 38: 124. 1899.

*Hedwigidium erosum* (Müll. Hal.) Par., Index Bryol. Suppl. 179. 1900.

*Hedwigidium maritimum* (Müll. Hal.) Par., Index Bryol. Suppl. 179. 1900.

*Braunia obtusiscuspis* Broth., Akad. Wiss. Wien Sitzungsber., Math.-Naturwiss. Kl., Abt. 1, 131: 214. 1923, *syn. nov.* TYPE: CHINA. Sichuan (Setchwang), Huili, Schuidjinggo prope Tungngan, 1,850 m, 21-III 1914, *Handel-Mazzetti 788* (H!, holotype; s!, isotype).

Brotherus (1923) described *Braunia obtusiscuspis* based on a sterile specimen from Sichuan province. The plants consist of shortly julaceous branches, imbricate leaves that are shortly ovate, concave with short acumina and recurved margins, and narrowly elongate leaf cells with central papillae. All these features point to the species, *Hedwigidium integrifolium* that is characterized by the broad perichaetial leaves, very short setae, strongly ribbed capsules, and small calyptrae with subtubulose base. Our examination of the type of *Braunia obtusiscuspis* indicates that it is identical to that of *H. integrifolium*. This species was already known from Hebei province (P.-C. Chen et al. 1978).

#### ACKNOWLEDGMENTS

We thank the curators of the following herbaria: BM, H, JE, NY, and S for the loan of the specimens on which this study was based. We are grateful to two anonymous reviewers for reviewing the manuscript and Dale Vitt for offering editorial comments. This work was supported in part by National Science Foundation Grant DEB-0072657 to the Missouri Botanical Garden.

#### LITERATURE CITED

- BESCHERELLE, P. E. 1892. Musci Yunnanenses. Énumération et description des mousses récoltées par M. l'abbé Delavay en Chine, dans les environs d'Hokin et de Tali (Yun-nan). Annales des Sciences Naturelles, Botanique, ser. 7, 15: 47–94.
- BROTHERUS, V. F. 1923. Musci novi sinensis collecti a Dre. Henr. Handel-Mazzetti. I. Akademie der Wissenschaften in Wien Sitzungsberichte, Mathematisch-naturwissenschaftliche Klasse, Abteilung 1, 131: 209–220.
- . 1925. Hedwigiaceae, pp. 66–75. In A. Engler & K. Prantl (eds.), Die natürlichen Pflanzenfamilien 11(2). Engelman, Leipzig.
- CHEN, P.-C., Z.-L. WAN, C. GAO, X.-J. LI, P.-C. WU, J.-X. LUO, M.-S. GUO & W.-Q. SHI. 1978. Hedwigiaceae, pp. 19–26. In P.-C. Chen (ed.), Genera Muscorum Sinicorum, II. Science Press, Beijing.
- DE LUNA, E. 1992. Developmental and systematic studies in the Hedwigiaceae (Musci). Ph.D. dissertation, Duke University.
- LIU, Z.-L. & C.-H. GAO. 1989. Mosses and liverworts, pp. 267–413. In B.-S. Xu (ed.), Cryptogamic Flora of the Yangtze Delta and Adjacent Regions. Science and Technology Publisher, Shanghai.
- , M.-J. LAI & C.-H. GAO. 1993. Bryophyta, pp. 47–96. In M.-Z. Zhang & M. J. Lai (eds.), Plants of Five Provinces in East China. Science and Technology Publisher, Shanghai.
- LUO, J.-X. 1985. Hedwigiaceae, pp. 240–242. In X.-J. Li (ed.), Bryoflora of Xizang. Science Press, Beijing.
- . 2000. Hedwigiaceae, pp. 465–470. In P.-C. Wu (ed.), Bryoflora of Hengduan Mts. (Southwest China). Science Press, Beijing.
- REDFEARN, P. L., JR., B. C. TAN & S. HE. 1996. A newly updated and annotated checklist of Chinese mosses. Journal of Hattori Botanical Laboratory 79: 163–357.
- WU, P.-C., D.-K. LI & C.-H. GAO. 1981. New records of bryophytes in Mt. Wuyi, China I. Journal of Wuyi Sciences 1: 16–18.

ms. received March 18, 2004; accepted April 27, 2004.